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ABSTRACT

This paper presents personal reflections on some aspects of the research project BRIDGE. The goal of this project is the development of mathematics teaching innovations in which students and teachers engage in mathematically rich situations through the creation of learning modules that capitalize on students' and their families' knowledge and experiences in their everyday lives. The four components of the model are described, but emphasis is placed on one part of the model--Study Groups--as the setting for discussing bridging in-school and out-of-school knowledge. Contains 14 references. (ASK)

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BRIDGING IN-SCHOOL MATHEMATICS AND OUT-OF-SCHOOL MATHEMATICS

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In this paper I present mostly a personal reflection on some aspects of our work in the research project BRIDGE[1]. The goal of this project is the development of mathematics teaching innovations in which students and teachers engage in mathematically rich situations through the creation of learning modules that capitalize on students' (and their families') knowledge and experiences in their everyday life. To accomplish this goal and the associated research questions, we rely on a model that has four key inter-related components: 1) Household Ethnographic Analysis; 2) Teacher-Researcher Study Groups; 3) Classroom Implementation; and 4) Parents as Learning Resources. I will briefly describe these four components, but my focus will be on the Study Groups as the setting where we work on bridging in-school and out-of-school knowledge.

Background

Our work takes place mostly in classrooms where the majority of students are of Mexican origin and economically disadvantaged. We reject a deficit theory model for the mathematics education of minority students. Instead, our research is grounded on the sociocultural approach to education that was developed in a prior project-- Funds of Knowledge for Teaching (Moll, 1992). Thus, a key premise in our work is to capitalize on the students' (and their families') experiences and knowledge as learning resources in school. How does this premise carry over to mathematics education? How can students' mathematical experiences outside school be brought to the foreground in ways that help them advance in their learning of school mathematics? (Civil, 1995a) This is a key question for us and in the study group meetings we keep coming back to it. Exploring the issue of pedagogical transformation of household, out-of-school mathematical knowledge into modules, themes, ideas that connect with in-school mathematics encompasses much of what takes places in the regular study group meetings. The exploration of this issue takes on many aspects in our sessions.

Who are we?

Currently, there are 5 University based researchers (anthropology, bilingual education, mathematics education); 3 middle school teachers (one of whom is on leave at the University just for this year); 5 elementary teachers (third, fourth, and fifth grade). There are two other teachers (one elementary, one middle school) who have participated in the past and are still interested in being in the project, but have not been involved in the last

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few months. In this paper, I will refer to the 8 teachers who are currently actively engaged in the project.

The middle school and two of the elementary schools serve a working class student population (90% to 95% Latino). The third elementary school serves a middle class population with a 35% to 40% Latino. One of the schools follows a very specific mathematics curriculum, based on a reform oriented textbook series. The other three schools have a less structured curriculum.

One aspect worth documenting is the commitment that such a research project entails. I am not only referring to time commitment, but to the fact that in this project we (where we is all of us) are working together towards the general research goal. We do not have a clear, linear process that we are following to get "there." I have been involved in professional development projects in mathematics, and so have many of the teachers currently participating in BRIDGE. In BRIDGE, there is a strong research component: the teachers are researchers (when they go into their students' homes, when they present and analyze findings in the study groups, when they read related articles and work on making connections to their classrooms, when they develop learning themes and try them out in the classroom). This in itself is often different from what teachers have experienced (e.g., inservice type experiences in which teachers are at the receiving end of ideas on how to teach mathematics). We are working together towards a common goal (that is open to different individual interpretations) which means that at times, things are fuzzy. We do not have an exemplary curriculum that we all explore together, or a series of activities on a specific topic in mathematics that we look at. Sometimes we explore mathematics as both learners and teachers, but many times, we are trying to make sense of how to build on students' diverse experiences in a way that does help them advance in their mathematical learning in school. And this issue takes different forms for each of us in this project. It is in this sense that I view BRIDGE as different from most professional development experiences that the teachers and myself have taken part in.

In BRIDGE, we are a small group, and thus we try to accommodate each individual's needs and interests. We (as in "staff") do not come in with an model to follow. We (all of us) are trying to develop that model. We bring in different experiences, needs, interests. This diversity certainly influences the structure of the study group discussions. The mathematical backgrounds and experiences of the participating teachers are quite varied. Most of them are experienced teachers. Six of them are bilingual and teach in bilingual classrooms. As for the reasons given for wanting to participate in project BRIDGE, they are equally varied. For example, one of the teachers has had prior experience with study groups and being a teacher-researcher. She enjoys the University-School collaboration,

and knows what this collaboration must look like for her to be willing and comfortable to take part in it. The reason why she joined this project is because she, herself, was intrigued by the question: "Can rigorous mathematics be developed from everyday mathematics?" She formulated this question, which ties directly to my research interest in this project. She is in the project to research this question by having access to the mathematical resources in the group. Another teacher not only has a very solid mathematics background but had previously taken a University course that focused on ethnographic training for the household visits, and was therefore familiar with the spirit of the current project. He has developed a very successful curriculum project for his seventh and eighth graders around the theme of "Build your dream home" (Fonseca, 1997) and has in a sense provided an "existence proof" to our research problem, a "yes, it can be done" type of experience. He is particularly interested in curriculum development that is grounded in students' experiences and in its assessment. Some of the teachers are particularly interested in the ethnographic component and in reaching out to their students' parents and the community in which they teach. Some are interested in the mathematical focus and view this project as a way to explore new ways to teach mathematics.

Another key factor that directly affects the dynamics of the study groups are the changes in participation. Four of the teachers have been in the project since the beginning; the rest joined it this year; also from last year, three teachers have left as well as one University researcher (another one joined the project this year).

An overview of the four components

The first three components (Household Ethnographic Analysis; Teacher-Researcher Study Groups; Classroom Implementation) are adapted from the prior project-- Funds of Knowledge for Teaching. I, as well as others, have presented these elsewhere (Civil, 1993; 1995c; González, 1995; Moll, Amanti, Neff, & González, 1992). Thus, rather than going over the structure, I will just give some highlights and pose some questions based on our most current work.

Household Visits

In a recent Study Group session, one of the teachers was describing her household visit. As she talked, I was drawn to this family and started feeling their struggles as well as the richness that this teacher had felt in her visit. As we discussed her visit, one of the teachers, who had recently joined the project, asked "how do you make the curriculum out of the home visits?" This, and similar questions, such as "how can visiting only one family help develop a theme for the whole class?" are questions that have been raised

before and that I am constantly wondering about. As a mathematics educator, as much as I enjoy the wealth of information that comes out of these household visits, I find myself constantly wondering about connections to the teaching of mathematics in school. The teacher who was describing her household visit replied that the effects cannot be seen necessarily in specific events, but that it was more of a holistic effect. "Once you start the interview and open the door, there's a lot that comes in," she said. By visiting this family, she had gained a perspective of who her student was that she did not have before and she knew that she would be drawing on this newly gained perspective in her future interactions with the student. It was her own narrative account of this teacher's household visit that most affected me and, I believe, the other study group members. This was very insightfully verbalized by one of the researchers, who consequently put it in writing. Here is what Marcia Brenden writes:

> An issue that is central to the project's approach to the household visits is the unlearning of normalized ways of seeing and documenting minority families. As C. outlined the single parent family she chose to interview, the profile could have been reduced statistically to a classic case of a family at risk: divorced, Mexican American mother and father; unstable home life with frequent moves and family in and out of shelters; mother and children now live in low income apartment; ...; absent father with a history of substance abuse and violent behavior...
>
> And yet, seeing this family in a personal way, ..., C. reports that she feels uplifted by the interactions, ... "they feel like a very rich family to me. They are not poor. They are very wealthy because of their togetherness." What then is the ethnographic interpretation of the resources in this family? How and why does this interpretation differ in intent and content from a sociological tally of how far this family falls from the mythologized norm of two-parent, middle class, white American family?
>
> The true product or "useable resource" that may result from this series of interviews is the qualitative interpretations of the strengths in this family. Spiritual resources are harder to document and perhaps less "useful" in curricular innovations than other types of resources. But what is most important is that a teacher has re-viewed a family that statistically could be written off as "in crisis" or "at risk" in order to document instead a single mother who exudes a positive and persevering response to life's circumstances. This mother is understood to be a resource for her children and their education. ... A statistically "at risk" family has been revalued as "at promise."

> ... Though the products of the interviews are not always tangible curriculum units, the process of the interviews may lead a teacher to new ways of contextualizing statistically "at risk" families that defy the prevalent cynicism surrounding seemingly intractable social problems. In this way, teachers, students, and families are actively involved as agents in the reflexive constitution of the process of education. [Marcia Brenden, working paper, February 1998]

This teacher's experience is by no means new. In fact, this was clearly a strength of the previous project (see González, 1995, for teachers' narratives on the impact of the household visits in the Funds of Knowledge for Teaching project). I am bringing it here because these are new teachers (in the sense that none of them were in the prior project) who joined BRIDGE because of an interest in the teaching of mathematics (where this interest takes many forms). In the Funds of Knowledge for Teaching project, mathematics was not the focus. Thus, the impact of household visits could take different forms in terms of curriculum implications. In BRIDGE, these implications should be in the area of mathematics, or so I thought. But in listening to the teachers talk about their household visits, I realize that these visits provide the teachers with enriched images of what some of their students' families are like. They provide a human connection that has clear affective impact on the teacher.

One teacher chose as the family to interview, the family of a boy who is quite good mathematically, but a rather poor reader and writer. He was intrigued by this difference and wanted to learn more about who this child is. He found his visit to the family an eye-opener. The father works in construction and this boy participates and is knowledgeable about his father's work. From the household interview, he learned that the child has many opportunities for mathematics explorations around the theme of construction. He also thinks that this boy developed many of his math skills because of a great interest in money: he goes to the swap meet and then has 'business' transactions at school. He also thought that because both his family and the teacher consider that math is important, he gives 100% performance in math. As he presented his findings to the rest of the study group participants, they gave him several suggestions on how to work on this student's reading and writing while building on his business interests. This is an important aspect of the study group dynamics-- the creation of a professional support group.

Another teacher, when interviewed shortly after her first household visits, said:

> It has allowed me to think about ways to involve parents in a different way. Literally involve the parents. [She then describes how one parent drew the plans for

how to build a burner for a hot air balloon, a theme she was exploring with her students].

As far as [the household visits] impacting my teaching (...) first is has to impact my thinking and then at some point it will impact my teaching. (Teacher's interview #1)

And maybe this is the biggest contribution from these household visits: they are impacting teachers' thinking and the images about who their students are.

Classroom Implementation

Originally, the idea was that the findings from the household visits would be discussed and analyzed in the study group sessions and curriculum units would be then planned and tried according to the different teachers' interests and circumstances. How does this translate when mathematics is the focus? To which extent can we expect teachers to focus their energy on mathematics, when they have to teach so many other subjects? This is something that one of the teachers, who is particularly engaged in the project, keeps reminding me of "Marta, I do have to teach things other than math." This teacher has developed a curriculum project around a garden theme. I cannot even begin to describe how much time, energy, and resources she has spent on this theme--not only concerning the mathematical content associated with a garden theme, but developing the garden, going on weekends and holidays to school to water the plants, covering them to protect them from cold weather, going to local gardening resource centers to gather information, etc.

This garden theme has provided not only a context for the students to learn mathematical concepts such as measurement and graphing (e.g., height of plants); area (e.g., of the garden); volume (e.g., amount of soil), but has also served as an opportunity for the development of a new community in the classroom, one that brings together students, teacher and parents. The mathematical explorations grounded on the garden theme led students and teacher to explore problems such as maximizing area, given a fixed amount of fencing, or the need for a scale in graphing the height of a plant. These problems are contextualized in the students' experiences with their gardens, but are then pushed in several directions to expand the inquiry process, all the while keeping in sight the curriculum of district required mathematics.

An interesting aspect of this project is the teacher's own learning of mathematics. This project has taken her into uncharted territory; she has been spending more time than she used to in the teaching of mathematics, and more specifically exploring geometry and measurement, much more than she had done in the past. This is a confident teacher who is aware of her knowledge and understanding of mathematics and is eager to learn more.

To which extent are the teacher's own understanding of and beliefs about mathematics key players in the process? For example, one of the most successful curriculum projects (from the point of view of engaging students in challenging mathematics, students who at the beginning of the year had shown no interest in the subject) was developed by a teacher/researcher who, besides being a very experienced teacher, has a background in mathematics and civil engineering. He is an skilled draftsman who was able to combine his knowledge and experiences with the interests and knowledge of this students (uncovered through informal interviews) to produce a solid architectural curriculum unit that engaged these middle school students in the study of the district required mathematics (and beyond).

Thus, in summary, the classroom implementation component takes different aspects depending on the teacher and his/her circumstances and interests. For example, one teacher is particularly interested in looking at mathematical discourse in her classroom and working on ways to engage students in mathematical discussions that may resemble what "mathematicians do." When in one of the Study Group sessions we discussed the article by Lampert (1990), she commented that she was really glad to have read this article because it corroborated many of the things she believed in and made her feel better in that she thought she was already doing some of what the article describes in her own teaching of mathematics. For example, she encouraged students' building of concepts and vocabulary in mathematics by prompting elaboration of their answers and reasoning. We have since then videotaped this teacher three times with the goal of engaging in a dialogue with her to find out how she views herself as a teacher of mathematics, her use of discourse, and her interpretation of how it relates to Lampert's article. For this teacher, the ethnographic aspect of the household visits is very important to the process of changing her teaching. The visits give her a personal connection that she believes she will be able to use to engage students in the discussion of mathematics.

Two other teachers work in a school district that has adopted an innovative, reform-oriented mathematics curriculum. It is a demanding curriculum for both teachers and students. Thus, we are also looking at ways to mesh the project goals with these teachers' needs. We think that the curriculum has a lot in common with our goals, in particular, in terms of giving students challenging tasks and using an inquiry-based instructional approach. But the truth is that this is new curriculum for these teachers, and we feel that our priority is right now on supporting them as they use this curriculum by, in the study groups, exploring mathematical topics that tie to what they are expected to teach.

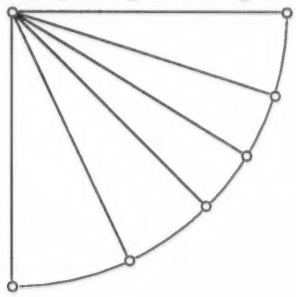
Yet, another teacher, who recently joined the project, is teaching middle school students who seem to have "no interest in being there." By her own initiative, she started

contacting family members of some of her students to try to understand how to better reach them academically. BRIDGE gives her an arena to raise and explore her issues and concerns. She and one other researcher are going to make a few "occupational interviews" [this is a new aspect of our project] of some of her students' parents (e.g., a seamstress, a carpenter) to then develop a curriculum unit to try to engage her students. In the meantime, another researcher is visiting her classroom several times a week to support the teacher, particularly by developing some mathematical activities to address the content she is expected to teach.

Parents as Learning Resources

One of the outcomes of the Funds of Knowledge for Teaching project was a redefinition of parental involvement on the part of many of the teachers in the project. The household visits provided them with an array of possibilities. Parents (and other family members) became resources who, for example, would come to the classroom and share their experiences and expertise on a variety of topics. This is still the case with one of our teachers. For her garden theme, she has had parents actively involved in a variety of ways. She even finally met the parents of one of her students who came to see their son's large production of tomato plants.

But, as we prepared for project BRIDGE, we wanted to do something else with parents. For one thing, because mathematics is the focus in our project, we want to better document the uses of mathematics by working class, minority adults in our local community. This has turned out to be a very hard "exercise." For example, what are the implications of noticing that a seamstress makes a quarter of a circle by holding her measuring tape fixed at one corner of her rectangle (the center) and marking points 25 cm from that point, then joining them to get her quarter circle?



Drawing an quarter of a circle

It certainly shows the circle as the geometric locus of points equidistant from a given point. But how can we use her knowledge to inform us for school mathematics? At the level of the study group, uncovering and analyzing the mathematics embedded in the

practice is very important to our profes onal development goals (González, Civil, Andrade, & Fonseca, 1997).

These discussions give us a context to explore mathematics, and to talk about our beliefs and values about what we count as "valid" mathematics. But, at least in my case, I am aware that my own training in "formal" or "academic" mathematics limits my analysis. Miller's (1992) paradox rings true in our work: "How can anyone who is schooled in conventional Western mathematics "see" any form of mathematics other than that which resembles the conventional mathematics with which she is familiar?" (p. 11)

Not knowing about the practices themselves is perhaps the main problem (this became evident to me in a recent discussion on carpet and tile laying). Thus, we want to continue our research on the "everyday mathematics" to gain a better understanding of the various forms and places in which mathematics occurs. We are doing this by interviewing adults in the community (we are now starting a set of interviews with parents of some of the students in one of the project schools) and then analyzing the interview in the Study Groups. However, this is still a one-sided approach: we have not yet engaged in a discussion of mathematics with the adults in question (Vithal & Skovsmose, 1997).

Consequently, another aspect of our work with parents, and this is the one where most of our efforts have focused, is the development of a core group of parents to engage in a two-way dialogue about the teaching and learning of mathematics. Eventually, we would like to have small core groups in all the schools we work in. But the logistics of getting such a project going have been quite complex (Andrade, working paper, 1998). We are currently working with a core group of working class, immigrant, Spanish speaking mothers. Through regular workshops, we explore these women's ideas about and understanding of mathematics, while maintaining a two-way conversation to better inform our work with their children. In many ways, these workshops reflect our approach to professional development for teachers. Thus, parents are seen as intellectual resources in that not only do they participate in the discussions but will then go to classrooms to teach what they are learning in these workshops. This is a different kind of parental involvement from what many minority, working-class parents usually experience (e.g., monitoring of cafeteria, organizing papers for a teacher, cutting things for an arts activity, ...). To better describe our intent in the work with parents, I will quote Andrade:

> Sarason (1994) has called for engaging the minds, hearts and voices of parents, students and teachers alike, if collaboration is to take place. This work of facilitating partnerships is complex, requiring a great many resources and reflection. Further, it is not mechanistic, for it requires taking each of the interactants into account. As

> Sarason has suggested, it is about engaging *minds, hearts and voices*. But above all, it is about the unspoken eloquence of humility, where everyone comes to learn, no one better than the other. (Andrade, Working Paper, January 1998)

Study Groups

The Study Groups are the key component to this project in that here is where we (teacher-researchers and university-based researchers) all come together to discuss the different aspects of our work. We meet every two weeks, for about two hours, in alternating schools. The content of the Study Group sessions has been quite varied. Some of the sessions centered around debriefing the household visits; others engage us in explorations of mathematics. These explorations in mathematics are largely grounded on the teachers' interests and needs. For example, in the case of the teacher who developed the garden project, that fact that her students had to change the shape of their group gardens to maximize area, led us to a hands-on exploration of area, perimeter, and volume and how the scale factor affects each of these. The fact that most of the teachers in the project have to teach "fractions" has led us to a discussion of teaching of fractions (based on teaching cases). Yet, more recently, some of these explorations have reflected our attempt to uncover the mathematics in everyday practices, as explained earlier (e.g., the work of a seamstress, or using Masingila's (1994) article as basis, a discussion on the mathematics of carpet and tile laying). Other study group sessions center around discussion of relevant articles on research on everyday cognition and mathematics, ethnomathematics, culture and mathematics, language and mathematics, and inquiry-based approaches to mathematics education.

The dynamics of the study group sessions are constantly changing, in part due to the changes in participation that I referred to earlier in the paper. We seem to have now reached a working model, by which we all take turns in facilitating the different sessions. Our more recent sessions have revolved around the issue of social vs. individual construction of knowledge in mathematics. We are still exploring this, and what I have to offer is very tentative, but I want to do so to give a flavor for what one study group session may be like and to also open this topic up for discussion here. (Note: in what follows I am paraphrasing from the transcript of one recent study group session, in an attempt to give the gist of the discussion.)

Our discussion centered around the question of whether in our project, we are conceptualizing learning as a sociocultural activity or as individual cognition. The notion of "level" emerged from different angles. One teacher replied that this issue (learning through interaction or individually) would depend in part on the level of difficulty of the task.

Another teacher then brought up the notion of there being different levels of mathematics, as she referred to the fact that she had met unschooled people in Mexico who were very good at basic mathematics through their work experience. This in turn brought up the questions of, if there are these levels of mathematics, is what we are doing BRIDGE only going to address the very basic mathematics? Are we not going to get into the more abstract mathematics? This is certainly a concern that several of us share and that I have brought up elsewhere (Civil, 1995a, 1995b). One of the study group members asked "is there necessarily a relation between the experiences with [everyday] mathematics and school mathematics? If you have too much school mathematics, does it erase our practical mathematics?" To this, I responded:

> This reminds me of Abreu's[2] article. I don't think that I could learn how to build a building [this comes from an earlier part of the discussion in which we were talking about the mathematics embedded in construction]. I don't know if I saw these people and interacted with them, I don't know. But I think that at this point, I already bring, on the one hand my preconceived notions of how bad I am at building things. But also, my knowledge of mathematics would influence my approach. For example [going back to Masingila's article] on finding the line in the middle of the room, I bet I would think about it in terms of school geometry, measuring, finding the bisector, etc. Maybe that is not the most efficient way of doing it, but I would only be able to bring that to it.
>
> You were saying something about basic mathematics, and I am not sure about this, I am not sure about this notion of levels; it goes back to Abreu's discussion on values. So going back to the question of "is BRIDGE only addressing basic mathematics?" The problem is how do you bring the different mathematics together and we at the same time not thinking that there is less value on the kids doing activities like the gardening. When you try to bring it into the classroom and have a discussion about the perimeter and area, you start loosing kids; they get disengaged. I am not sure it is because the mathematics is more abstract. I don't know what it is really. I don't deny there are different levels of knowledge, but I am not sure one is higher than another. I am struggling with this issue constantly in my own teaching. For example in the Freshman level class I teach, we were working on tessellations. They were making patterns, putting things together, but as soon as I tried to get them to look at the mathematics in all this, most of them did not seem interested in knowing why the regular pentagon does not tessellate, while the regular hexagon does.

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[2] I am referring to Abreu, 1995.

In Closing

In closing this paper, I would like to bring up three issues related to the Study Groups that come to mind as I reflect on our work in the project.

1) What about our funds of knowledge? One of the goals of the project is to uncover families' funds of knowledge. Yet, as Marcia Brenden noticed recently as she talked to one of the teachers and found out about his interest and knowledge about astronomy, we have not worked on uncovering the teachers' funds of knowledge. In fact, I would add, we have not discussed our own funds of knowledge, of each of us in the group. This not sharing "who we are", "what we know" has, I think, direct implications on the dynamics of the study group sessions, as we may be tempted to bring in prior experiences and expectations about professional development projects.

2) Issue of authority. In the beginning, the study group meetings were run by University staff. Again, this conforms to the model that many of us may have experienced in other professional development programs. The facilitating of the meetings has now moved to a point where it rotates among the different members. But there is still an issue of ownership. We have been trying to address the question of "what do you want to get out of these meetings?" "How do you want them to function?" I think that some teachers still do not feel like they "own" the project and are not sure whether they want to facilitate a meeting. Of course, the fact that some teachers leave the project and others come in, make it harder to develop a sense of continuity. It is not like other projects I have had experience with, in which teacher attrition does not affect the content, because we (the staff) provide the activities, the teaching, the discussion questions, etc. In BRIDGE, we are co-dependent. We are carrying out a conversation. Can newcomers catch up?

3) Theory and Practice. In the Study Group meetings, we sometimes engage in what could be considered more practice focused sessions (e.g., exploring classroom activities on fractions). At other times, we focus more on theoretical discussions around the work that we are doing. An example of this may be the recent discussion (illustrated earlier) on learning as individual cognition or as a sociocultural activity. Some of the participants want more practice focused sessions. Others, enjoy the theoretical discussions. As one teacher remarked, reading a given article for the third time was the breakthrough for her: she made connections between her practice and the theoretical framework laid out in the article. We are striving, I think, for these connections, but trying to keep the balance between theory and practice is often a challenge when we factor in all the different pressures and needs that the different project participants have (e.g., for teachers it may be the district assessments that they have to give: they want suggestions on how to prepare students for those, or just suggestions that they perceive as relevant to their everyday teaching; for University based

researchers, it may be related to the fact that we come from different disciplines and thus may have different expectations and kinds of pressures that affect what we would like to see happening in the study group sessions).

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